

METAL SUSPENSION SYSTEMS FOR LAY-IN PANEL CEILINGS: 2010 CBC

IR 25-2.10

References:

California Code of Regulations (CCR), Title 24,
Part 2: 2010 California Building Code (CBC), Section 1615A.1.16,
1615.10.13*
ASTM C635-07, C636-06, and E580-08

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Discipline: Structural

This Interpretation of Regulations (IR) is intended for use by the Division of the State Architect (DSA) staff, and as a resource for design professionals, to promote more uniform statewide criteria for plan review and construction inspection of projects within the jurisdiction of DSA which includes State of California public elementary and secondary schools (grades K-12), community colleges and state-owned or state-leased essential services buildings. This IR indicates an acceptable method for achieving compliance with applicable codes and regulations, although other methods proposed by design professionals may be considered by DSA.

This IR is reviewed on a regular basis and is subject to revision at any time. Please check the DSA web site for currently effective IRs. Only IRs listed in the document at <http://www.dgs.ca.gov/dsa/Resources/IRManual.aspx> at the time of plan submittal to DSA are considered applicable.

* Indicates alternative 2010 CBC sections that may be used by community colleges, per 2010 CBC Section 1.9.2.2.

PURPOSE: The purpose of this Interpretation of Regulations (IR) is to provide guidelines for the installation of metal suspension systems for lay-in ceilings on projects approved under the 2010 California Building Code (CBC). For projects submitted to DSA for review under the 2001 or 2007 CBC, see IR 25-2.01 or IR 25-2.07 respectively.

1. GENERAL REQUIREMENTS: CBC Section 1615A.1.16 (1615.10.13*) requires the design and installation to be in compliance with ASTM C635, C636, and E580, Section 5, as amended by 2010 CBC Section 1615A.1.16 (1615.10.13*).

Note: Amendments in CBC Section 1615A.1.16 (1615.10.13*) replace ASCE 7, Section 13.5.6.

The requirements in this IR apply to ceiling systems whose total weight, including ceiling mounted air terminals, services and light fixtures, does not exceed four (4) psf. Heavy systems, and those supporting lateral loads from partitions, will require special design details.

2. SUSPENSION SYSTEM COMPONENTS: shall comply with ASTM C635 and E580 Section 5.1.

- 2.1** The ceiling grid system must be rated heavy duty as defined by ASTM C635.
- 2.2** Suspension wires shall be #12 gage (0.106" diameter), soft annealed, and galvanized steel wires with Class 1 coating.
- 2.3** Main runners, cross runners, splices, expansion devices, intersection connectors shall be designed to carry a mean ultimate test load of not less than 180 lbs. in compression and tension per ASTM E580 Section 5.1.2.

3. SUSPENSION SYSTEM INSTALLATION: shall comply with ASTM C636 and E580 Section 5.2.

- 3.1** #12 gage hanger wires may be used for up to and including 4 ft. by 4 ft. grid spacing and shall be attached to main runners.
- 3.2** Provide #12 gage hanger wires at the ends of all main and cross runners within eight (8) inches of the support or within one-fourth (1/4) of the length of the end tee, whichever is least, for the perimeter of the ceiling area. See Figure 2. Perimeter wires are not required when the length of the end tee is eight (8) inches or less.

- 3.3** Ceiling grid members shall be attached to two (2) adjacent walls per ASTM E580 Section 5.2.3. Ceiling grid members shall be at least 3/4 inch clear of other walls. If walls run diagonally to ceiling grid system runners, one end of main and cross runners should be free, and a minimum of 3/4 inch clear of wall.
- 3.4** The width of the perimeter supporting closure angle shall be not less than 2 inches. Grid systems with specialty angles and support clips may be acceptable in accordance with Section 11 below.
- 3.5** At the perimeter of the ceiling area where main or cross runners are not connected to the adjacent wall, provide interconnection between the runners at the free end to prevent lateral spreading. A metal spreader strut or a #16 gage wire with a positive mechanical connection to the runner may be used. Where the perpendicular distance from the wall to the first parallel runner is 8 inches or less, this interlock is not required.

4. EXPANSION JOINTS, SEISMIC SEPARATION JOINTS, AND PENETRATIONS:

- 4.1** Expansion joints shall be provided in the ceiling at intersections of corridors and at junctions of corridors and lobbies or other similar areas. See Figure 7 Detail A.
- 4.2** For ceiling areas exceeding 2500 square feet, a seismic separation joint shall be provided in accordance with Figure 7 Detail A to divide the ceiling into areas not exceeding 2500 square feet. Alternatively, comply with ASTM E580-08 Section 5.2.9.
- 4.3** Penetrations through the ceiling for sprinkler heads and other similar devices that are not integrally tied to the ceiling system in the lateral direction shall have a two (2) inch oversized ring, sleeve or adapter through the ceiling tile to allow free movement of one (1) inch in all horizontal directions. Alternatively, per ASTM E580 Section 5.2.8.8, a flexible sprinkler hose fitting that can accommodate 1 inch of ceiling movement shall be permitted to be used in lieu of the oversized ring, sleeve or adapter.

- 5. LATERAL FORCE BRACING:** Lateral force bracing is required per this section for all ceiling areas. The spacing of the bracing assemblies must be shown on the construction documents.

Exception: Lateral force bracing may be omitted for suspended acoustical ceiling systems with a ceiling area of 144 square feet or less, and fire rated suspended acoustical ceiling systems with a ceiling area of 96 square feet or less, when perimeter support in accordance with Section 3.4 of this IR or with ASTM E580 Sections 5.2.2 and 5.2.3 are provided and perimeter walls are designed to carry the ceiling lateral forces.

- 5.1** Provide lateral-force bracing assemblies consisting of a compression strut and four (4) #12 gage splayed bracing wires oriented 90 degrees from each other (see Figure 1).
- 5.2** Lateral-force bracing assemblies shall be spaced at a maximum of 12 feet by 12 feet on centers for school buildings and 8 feet by 12 feet on centers for essential services buildings, with the first assembly within half the maximum spacing from each wall and at the edges of any change in elevation of the ceiling. The last assembly must be within maximum distance from each wall.
- 5.3** The slope of bracing wires shall not exceed 45 degrees from the plane of the ceiling and wires shall be taut. Splices in wires are not permitted without special DSA approval.

- 5.4** Compression struts shall be adequate to resist the vertical component induced by the bracing wires, and shall not be more than 1 (horizontal) in 6 (vertical) out of plumb.

6. ATTACHMENT OF HANGER AND BRACING WIRES:

- 6.1** Fasten #12 hanger wires with not less than three (3) tight turns in 3 inches. Hanger wire loops shall be tightly wrapped and sharply bent to prevent any vertical movement or rotation of the member within the loops (see ASTM E580, Section 5.2.7.2).
- 6.2** Fasten #10 or #12 bracing wires with four (4) tight turns. Make all tight turns within a distance of 1-1/2 inches.
- 6.3** Hanger or bracing wire anchored to the structure should be installed in such a manner that the direction of the anchor aligns as closely as possible with the direction of the wire.
- 6.4** Separate all ceiling hanger and bracing wires at least six (6) inches from all unbraced ducts, pipes, conduit, etc.
- 6.5** Hanger wires shall not attach to or bend around interfering material or equipment. Provide trapeze or other supplementary support members at obstructions to typical hanger spacing. See Figure 3A, Detail F. Provide additional hangers, struts or braces as required at all ceiling breaks, soffits, or discontinuous areas.
- 6.6** Hanger wires that are more than 1 (horizontal) in 6 (vertical) out of plumb shall have counter-sloping wires. Perimeter hanger wires at main runners that are positively attached to the perimeter closure angle, counter-sloping is optional.
- Note :** See ASTM C-636 Figure 1 for counter-sloping methods.
- 6.7** When connection details differ from those in the attached figures, attachment of bracing wires to the structure above and to the main runners shall be adequate for the load imposed. The weight (W_p) shall be taken as not less than 4 psf for calculating seismic forces (F_p).
- 6.8** When drilled-in concrete anchors or shot-in anchors are used in reinforced concrete for hanger wires, 1 out of 10 wire/anchor assemblies must be field tested for 200 lbs. in tension. When drilled-in concrete anchors are used for bracing wires, 1 out of 2 wire/anchor assemblies must be field tested for 440 lbs. in tension in the direction of the wire. Shot-in anchors in concrete are not permitted for bracing wires.

Note: Drilled-in or shot-in anchors require special DSA approval prior to use in prestressed concrete.

- 7. CEILING FIXTURES, TERMINALS, AND DEVICES:** All fixtures, terminals, and other devices shall be mounted in a manner that will not compromise ceiling performance in accordance with Section 13.5.6.2.2(5) of ASCE 7-05 as amended by 2010 CBC Section 1615A.1.16 (1615.10.13*) and ASTM E580 Sections 5.3 and 5.4.

- 7.1** Ceiling panels shall not support any light fixtures, air terminals or devices.
- 7.2** Attach all light fixtures, ceiling mounted air terminals and all other devices to the ceiling grid runners to resist a horizontal force equal to the weight of the fixtures. Screws or approved fasteners are required. Minimum of two attachments are required at each light fixture per ASTM E580 Section 5.3.1.
- 7.3** Recessed or drop-in light fixtures, grilles, mechanical terminals, and flexible sprinkler hose fittings or other services be supported directly on runners classified as ASTM heavy duty, but they must also have a minimum of two (2) #12 gage slack safety wires attached to the fixture at diagonal corners and anchored to the structure above.

- 7.4** All flush or recessed light fixtures, mechanical terminals, and flexible sprinkler hose fittings or other services weighing 56 lbs. or more must be independently supported by not less than four (4) taut #12 gage wires attached to the housing and to the structure above. The four (4) taut #12 gage wires, including their attachment to the structure above, must be capable of supporting four (4) times the weight of the unit
- 7.5** All 4 ft. x 4 ft. light fixtures must have slack safety wires at each corner.
- 7.6** Surface-mounted fixtures shall be attached to the main runner with at least two positive clamping devices made of material with a minimum #14 gage. Rotational spring catches do not comply. A #12 gage suspension wire shall be attached to each clamping device to the structure above. Provide additional supports when light fixtures are 8 ft. or longer. Maximum spacing between supports shall not exceed 8 feet.
- 7.7** Support pendant-mounted light fixtures directly from the structure above with hanger wires or cables passing through each pendant hanger and capable of supporting two (2) times the weight of the fixture. A bracing assembly, per Figure 1, is required where the pendant hanger penetrates the ceiling. Special details are required to attach the pendant hanger to the bracing assembly to transmit horizontal force. If the pendant mounted light fixture is directly and independently braced below the ceiling, i.e. aircraft cables to walls, then brace assembly is not required above the ceiling. See [IR 16-9](#) for additional requirement for pendent mounted fixtures.
- 7.8** All light-weight miscellaneous devices, such as strobe lights, speakers, etc., shall be attached to the ceiling grid per Section 7.1 of this IR. In addition, devices weighing more than 10 lbs shall have a #12 slack safety wire anchored to the structure above. Devices weighing more than 20 lbs shall be supported from the structure above per Section 7.3 of this IR.

8. ADDITIONAL REQUIREMENTS:

8.1 Fire Rated Ceilings:

Provide a detail and design number for rated ceiling assemblies from an authorized testing agency. The components and installation details must conform in every respect with the listed detail and number. Details shall clearly depict all components, including insulation materials, framing and attachment of the design so that the assembly can be constructed and inspected accordingly.

Pop rivets, screws, or other attachments are not acceptable unless specifically detailed on the drawings and approved by U.L. and State Fire Marshal. (SFM) recognized laboratories.

8.2 Metal and Other Panels:

Metal panels and panels weighing more than 1/2 psf, other than mineral fiber acoustical tile, are to be positively attached to the ceiling suspension runners.

8.3 Essential Services Buildings:

Exitways shall be installed in accordance with Section 13.5.6.2.2(1) of ASCE 7-05 as amended by 2010 CBC Section 1615A.1.16 (1615.10.13*). A main or cross runner shall be installed on all sides of each piece of tile, board or panel and each light fixture or grill (see Figure 7 Detail B). Splices or intersection of such runners shall be attached with through connectors such as pop rivets, screws, pins, plates with end tabs or other approved connectors.

8.4 Suspended Acoustical Ceilings Below Gypsum Board Ceilings:

Where gypsum board or other ceiling finishes are attached to the framing, specific details will be required for the vertical hanger wire and lateral bracing wire support connections to the framing.

9. RE-USE OF EXISTING CEILING HANGER WIRES AND BRACING WIRES:

9.1 The gage and spacing of the wires must comply with the current applicable codes.

9.2 All existing ceiling hanger wire/anchor assemblies must be tested to 200 lbs.

9.3 All existing bracing wire/anchor assemblies must be field tested to 440 lbs.

9.4 If a new wire is to be spliced to an existing wire, the following is required:

- The architect or structural engineer in general responsible charge must submit to DSA a detail and specification describing how the splice is to be made.
- All new wires, after being spliced to the existing wires, must be field tested per Sections 9.2 and 9.3 above.
- All field tests must be performed in the presence of the project inspector.

10. MODERNIZATION AND ALTERATION: The entire ceiling shall be upgraded to meet the current requirements of the CBC and this IR if any portion of the grid system is cut or altered.

Exception: The replacement of existing ceiling panels with panels of the same materials and light fixtures of the same size, locations, and weights does not require an upgrade to the ceiling grid and suspension system.

11. DSA ACCEPTANCE REPORT: DSA no longer issues Acceptance Reports for products. Ceiling grid systems or components, with valid evaluation reports issued by qualified evaluation agencies in accordance with DSA [IR A-5](#), are accepted by DSA, provided the system or component meets the requirements of CBC Section 1615A.1.16 (Section 1615.10.13 for CC), ASTM C635, C636 and E580. Where qualified evaluation report is utilized, the installation shall comply with all the requirements specified in the evaluation report, i.e. connections, member sizes, perimeter details, special clips to wall angles, etc.

12. CONSTRUCTION DOCUMENTS: Drawings and specifications shall clearly identify all systems and shall define or show all supporting details, lighting fixture attachment, lateral force bracing, partition bracing, seismic separations, etc. Where differences occur between provisions of this IR and the CBC, the provisions of the CBC shall apply.

A list of acceptable grid systems must be shown on the drawings. The grid systems specified shall have valid evaluation reports in accordance with IR A-5. The following information shall be included on the drawings for each acceptable grid system specified:

Classification of ceiling grid is heavy duty.

Manufacturer's catalog number - main runner (1) (2).

Manufacturer's catalog number - cross runner (2) (3).

Manufacturer's catalog number of detail for runner splice (2).

Notes: (1) Main runners must be rated as heavy duty.

(2) Show manufacturer, duty classification and catalog numbers.

(3) If a cross runner supports light fixtures, air terminals, or other cross runners, it shall be considered a main runner for the purpose of structural classification.

Figure 1
SUSPENDED CEILING BRACING ASSEMBLY

Compression struts:

Compression struts shall not replace hanger wires. The sizes of compression struts must be shown on construction documents by the engineer or architect. Attach compression struts to main runners within 2" of cross runner. Details of attachment at both ends must be designed and shown on construction documents by the engineer or architect. The attachment at the top shall be capable of supporting four times the weight of the strut.

Note:
See Figures 3, 4, 5, or 6 for
connections of bracing
and hanger wire to the
structure above

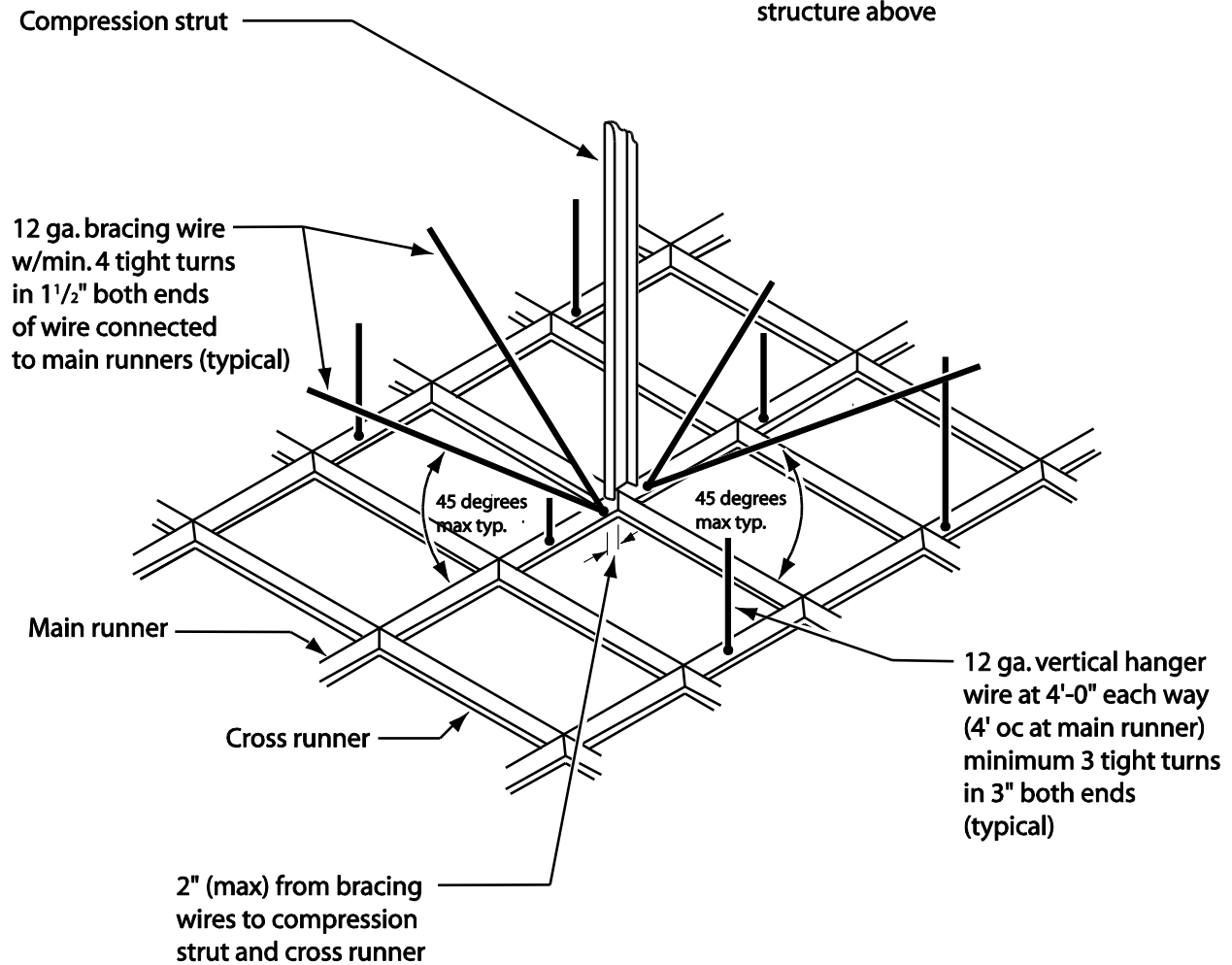
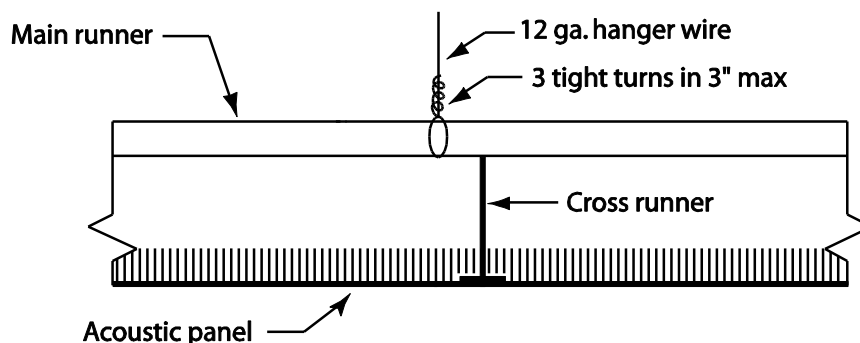
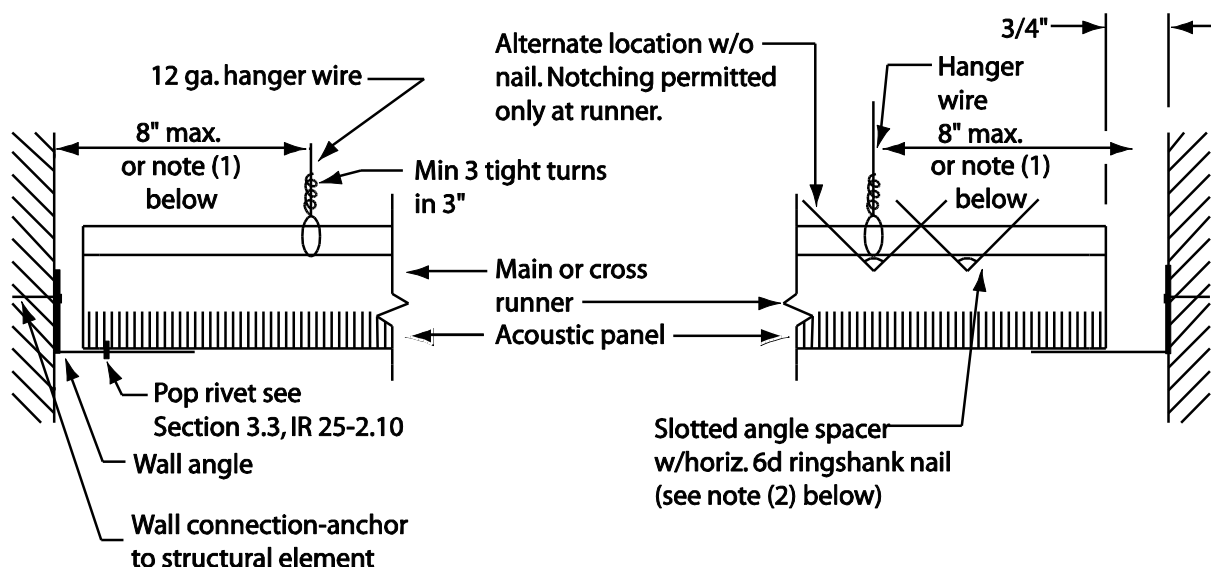


Figure 2
CEILING HANGER DETAILS



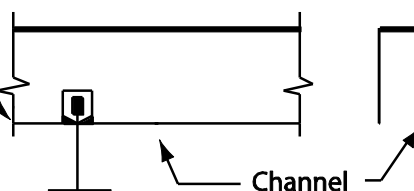
(A) Typical hang wire grid



(B) Perimeter details - typical (see Section 3.5)

- Notes: (1) 1/4 of the length of the end runner whichever is less.
(2) Nails at the end of horizontal struts are to be placed with nail head toward centerline of span of strut.
(3) Hanger wire not required for cross runners less than 8" long between main runner and wall.

Spacers may be slotted angles or channels with "diamond points" of spring steel which snap tight to prevent movement of strut.

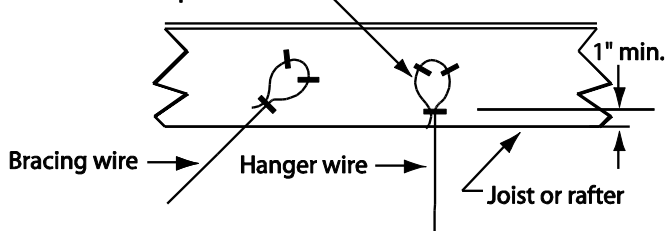


(C) Alternate Spreader Strut

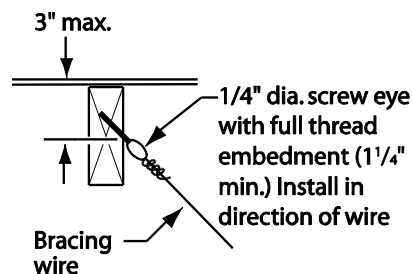
Figure 3A

ACCEPTABLE DETAILS - WIRE CONNECTIONS TO WOOD FRAMING

Three 1½" x 9 ga. staples or 3-stronghold "J" nails at each wire loop

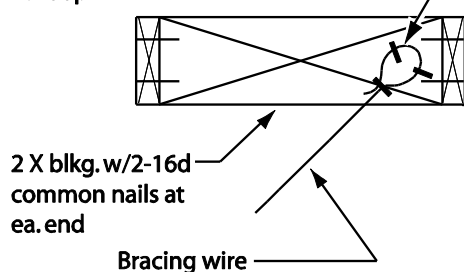


(A) Wood joist or rafter

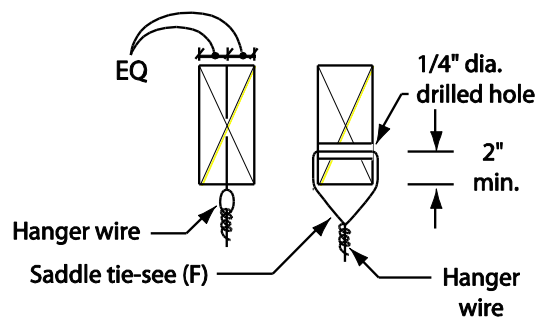


(B) Wood joist or rafter

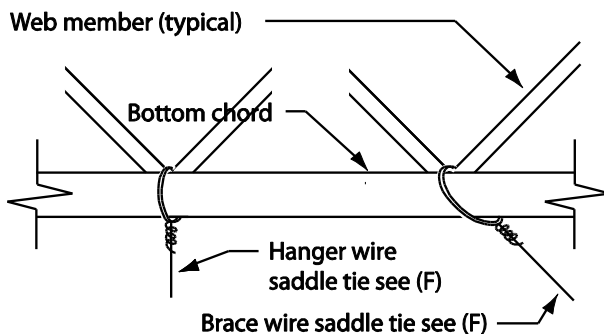
Three 1½" x 9 ga. staples or three stronghold "J" nails at each wire loop



(C) Wood joist or block



(D) At bottom of joist



(E) Bracing wire parallel to wood truss

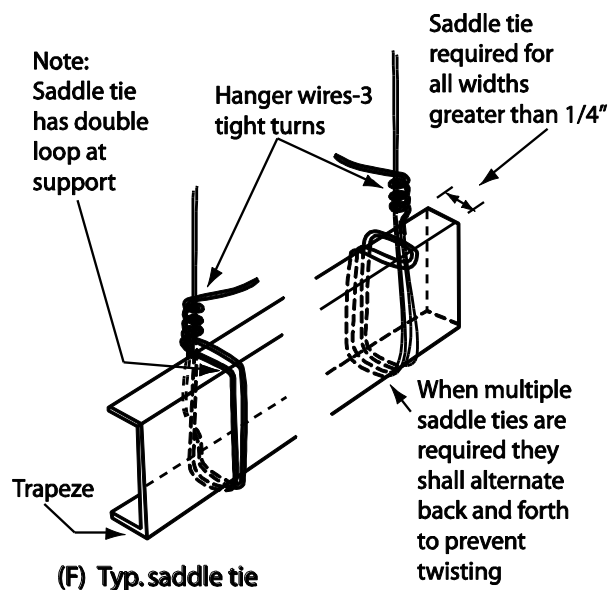
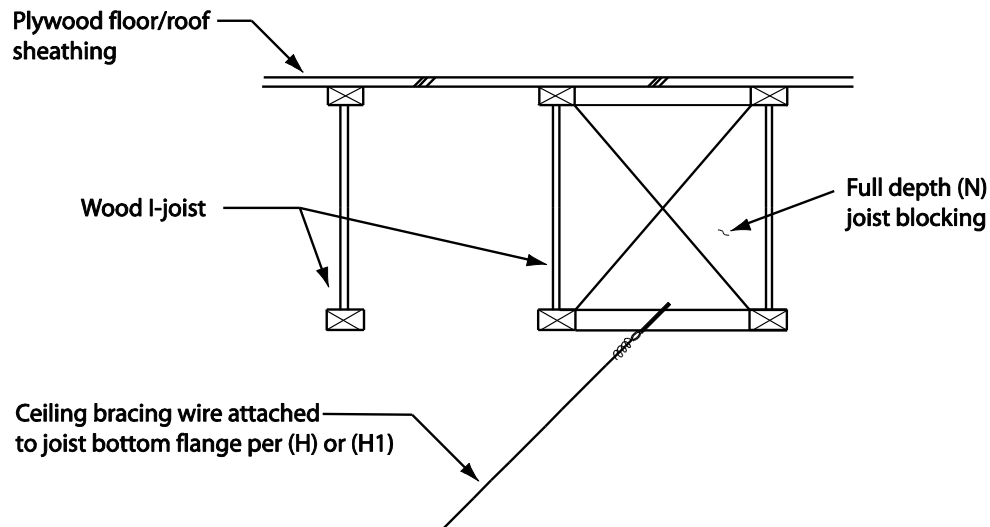
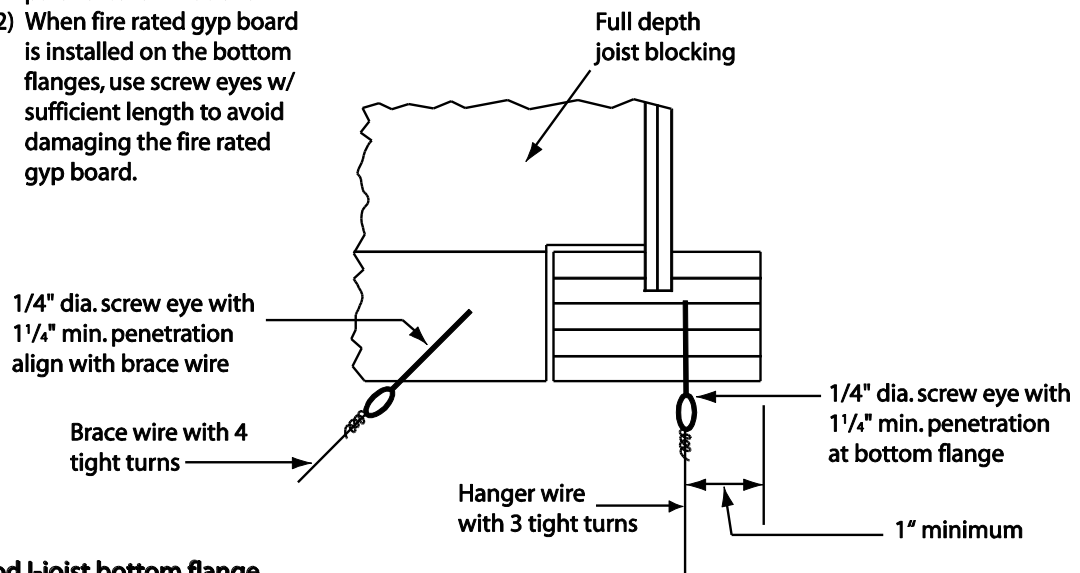


Figure 3B
ACCEPTABLE DETAILS - WIRE CONNECTION AT WOOD FRAMING



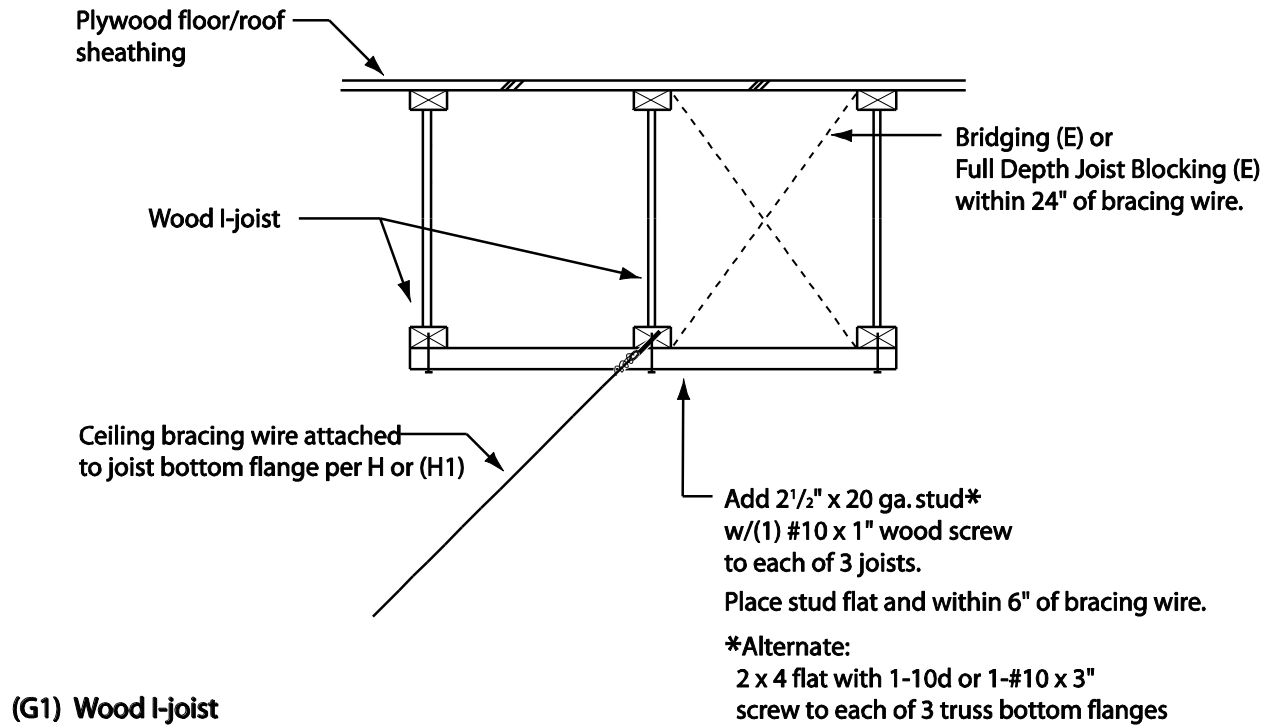
(G) Wood I-joist

- Notes: (1) Do not insert screw eyes parallel to laminations
(2) When fire rated gyp board is installed on the bottom flanges, use screw eyes w/ sufficient length to avoid damaging the fire rated gyp board.



(H) Wood I-joist bottom flange

Figure 3C
ACCEPTABLE DETAILS - WIRE CONNECTION AT WOOD FRAMING



Note: (1) Do not insert screw eyes parallel to laminations.
(2) When fire rated gyp board is installed on the bottom flanges, use screw eyes w/ sufficient length to avoid damaging the fire rated gyp board.

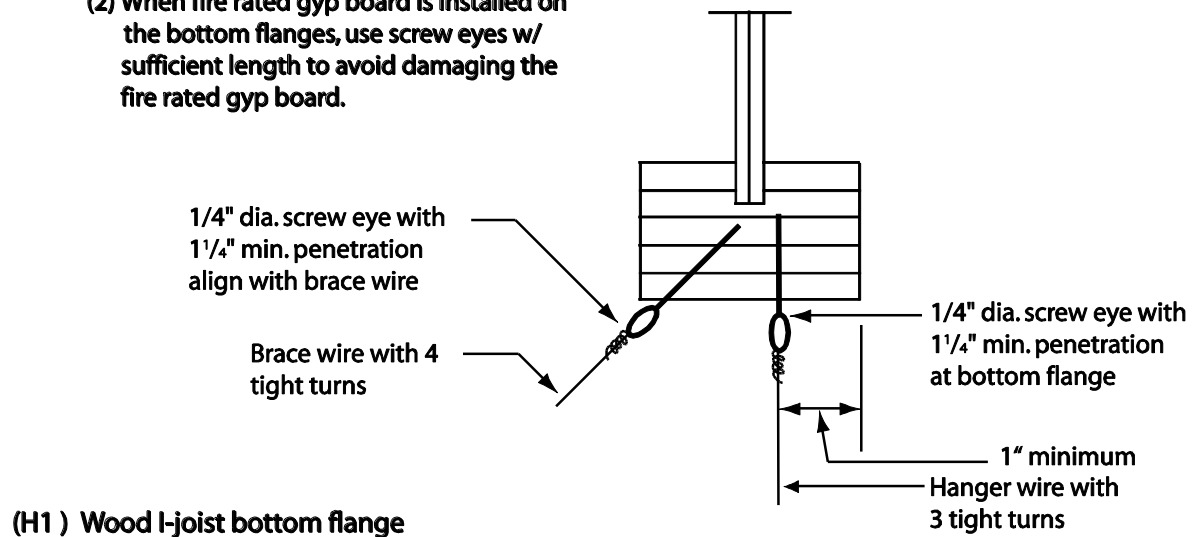
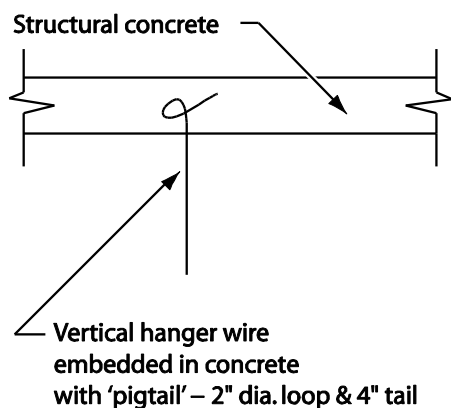
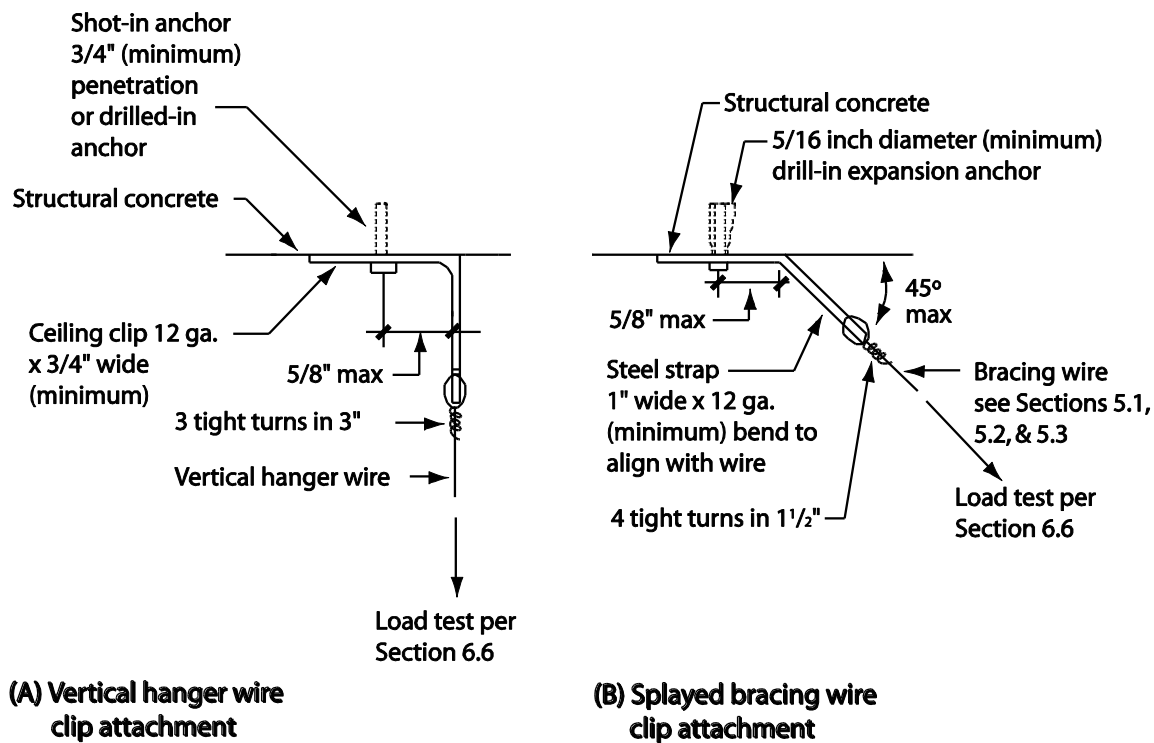
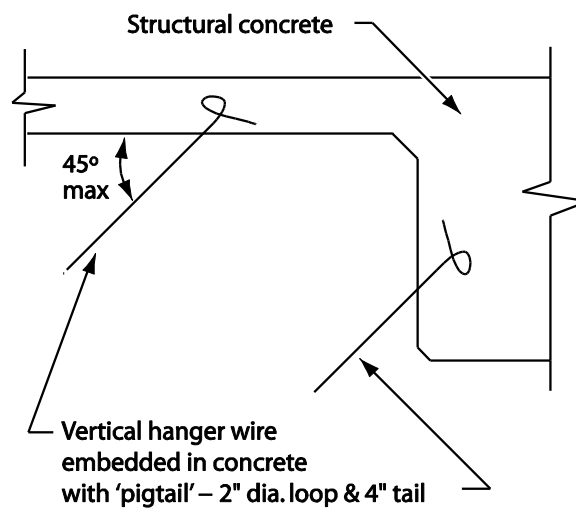


Figure 4 ACCEPTABLE DETAILS - WIRE CONNECTION TO CAST-IN-PLACE CONCRETE

Shot-in anchors not allowed for bracing wires

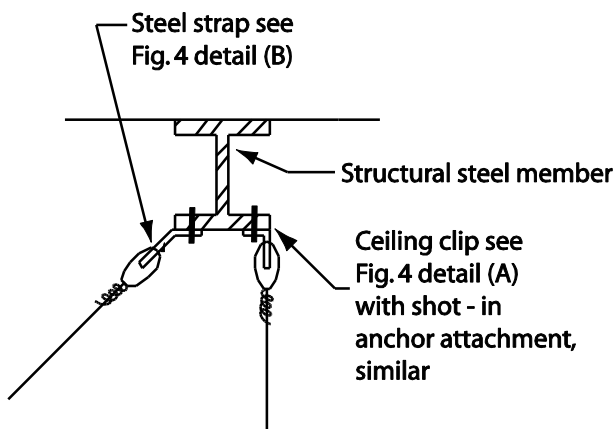


(C) Hanger wire at C.I.P. concrete

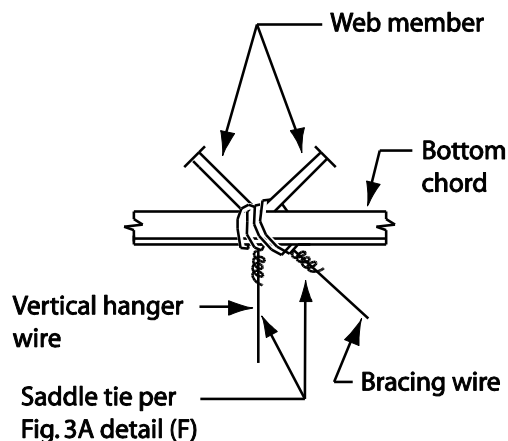


(D) Brace wire at C.I.P. concrete

Figure 5
ACCEPTABLE DETAILS - WIRE CONNECTIONS TO STEEL FRAMING

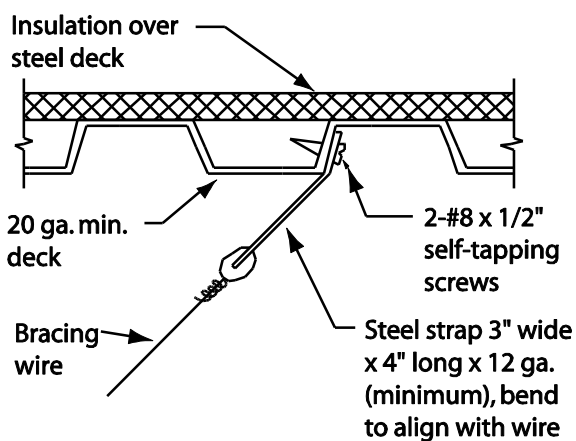


(A) At steel beams

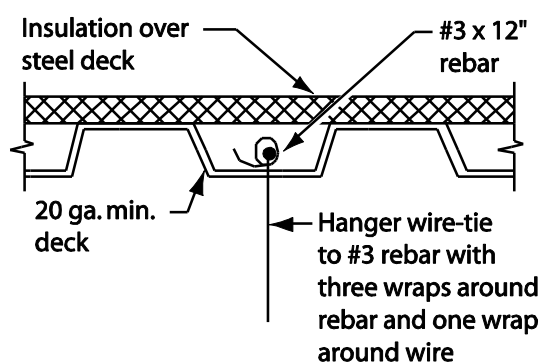


Brace wires parallel to joist.
Brace wires can not be perpendicular to joist.

(B) At open-web steel joist



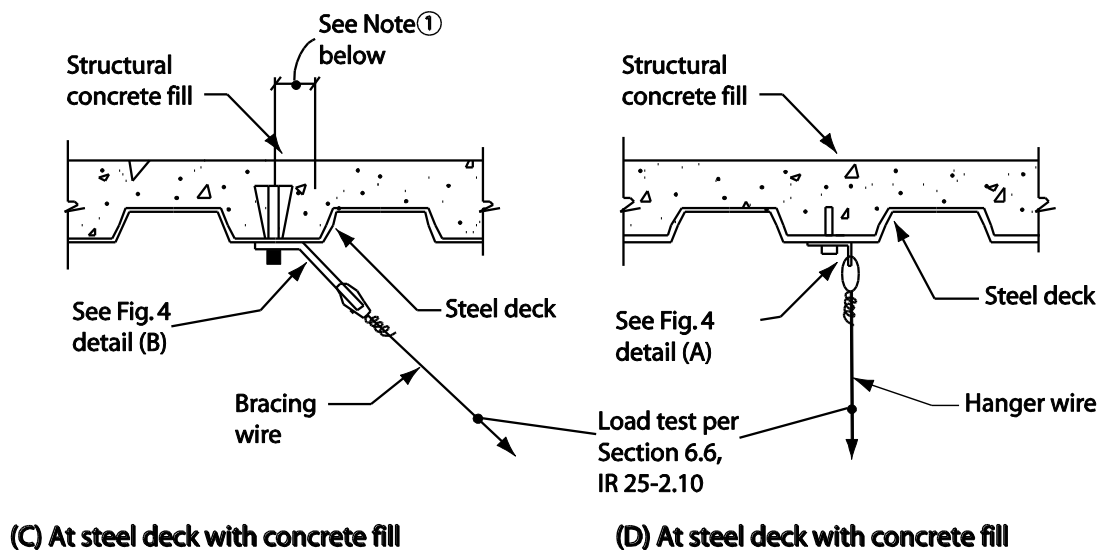
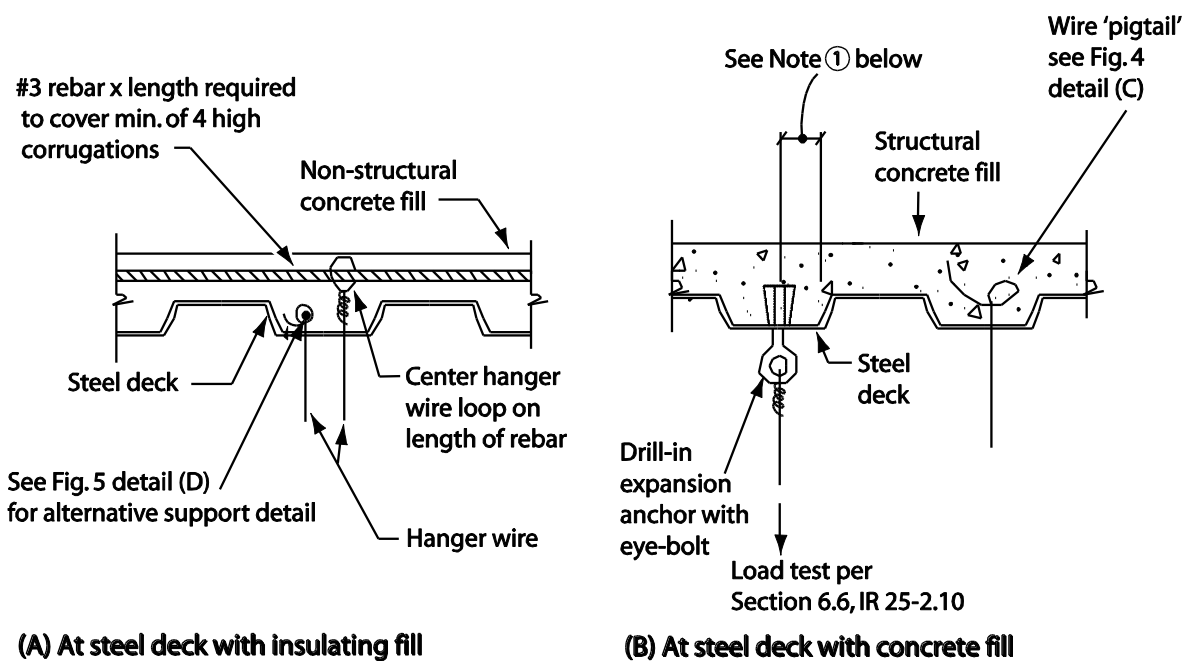
(C) At steel roof deck



(D) At steel roof deck

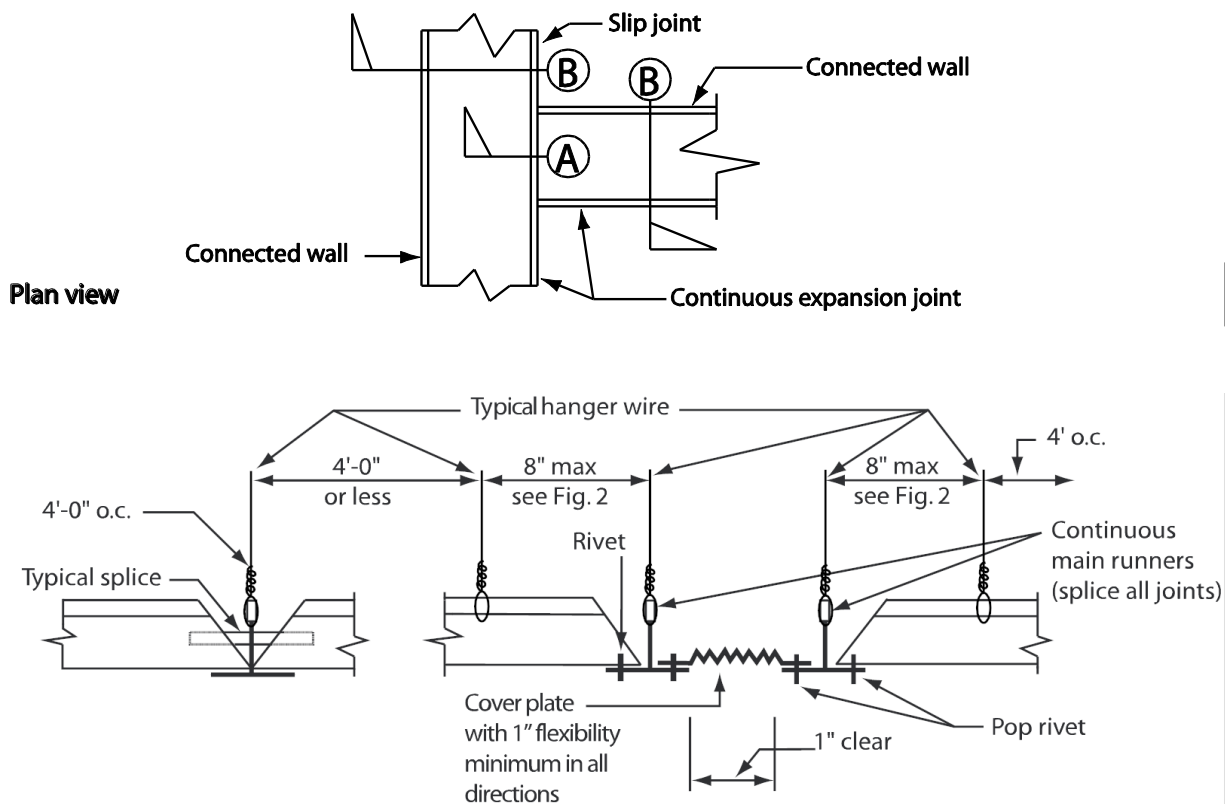
Note: If self-tapping screws are used with concrete fill, set screws before placing concrete

Figure 6
ACCEPTABLE DETAILS - WIRE CONNECTIONS TO STEEL DECK

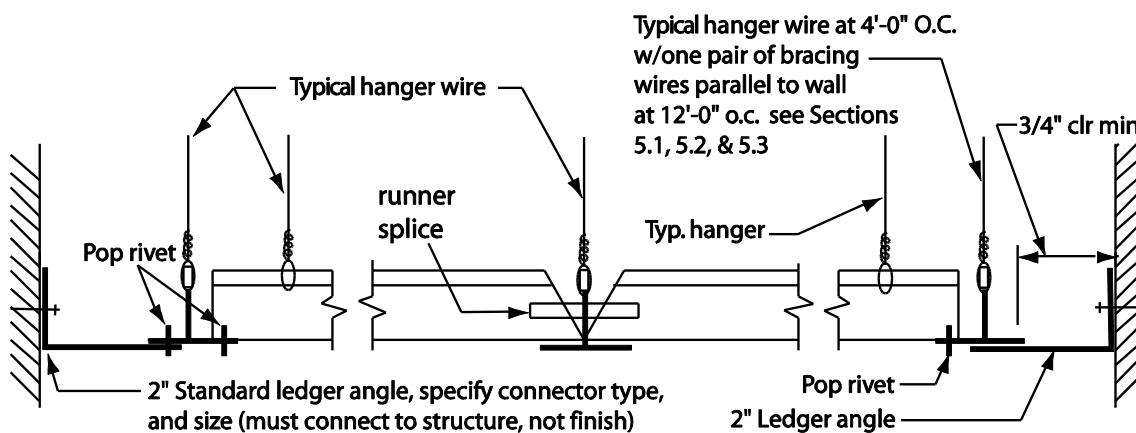


Note: ① Show minimum required distance per manufacturer's evaluation report issued by ICC-ES or other qualifying evaluation agency per IR A-5.

Figure 7
ACCEPTABLE LOCATION OF EXPANSION JOINTS IN EXITWAYS



- A** Expansion joint at intersections of corridors, junctions of corridors and lobbies, similar areas and ceiling areas over 2500 sq. ft.



Connected wall for Essential Services Buildings.
For schools see Fig. 2 (B).

Wall slip

- B** Acceptable exitways details